

OAKLAND ASR  
OAKLAND, CALIFORNIA

AIR CONDITIONING REPLACEMENT PROJECT

DIVISION 1

GENERAL REQUIREMENTS

1-1.0 SCOPE: Furnish all labor, equipment and materials to replace the air conditioning systems specified herein or shown on the drawings must be complete, functional, and operational in all respects. Equipment to be installed or replaced includes, but is not limited to, the following:

1. Replacement of one EA 12-1/2 ton packaged air conditioning unit and disconnect switch.
2. Installation of one EA 10 ton split system air conditioner, including concrete pad, refrigerant piping, conduit, conductors, thermostat and wiring, and disconnect switch.
3. Replacement of one each 2-1/2 ton split system air conditioner, refrigerant piping, breaker and disconnect switch.
4. Replacement of exterior ductwork associated with AC-1 and AC-2.

1-2.0 PROJECT LOCATION:

Oakland ASR  
Oakland International Airport,  
Oakland, CA

1-3.0 STATEMENT OF WORK:

Furnish all labor, equipment and materials to replace the air conditioning systems specified herein or shown on the drawings. Systems must be complete, functional, and operational in all respects. Equipment to be replaced must be as listed below:

The Contractor must provide 2 gauge sets and associated hoses (Imperial 644-C, suitable for R410a or equal) as well as 1 – 30 lb. cylinder of R410a to the FAA at the end of the project.

All units to include low ambient kits installed, or to provide for low ambient operation to 25 deg F. CU-5/AHU-5 refrigerant circuits to include device and piping arrangement as described in the project drawings.

1. New AC-2. Replace one 12-1/2 ton packaged air conditioner (AC-1) and disconnect switches for two units (AC-1 and AC-2).
  - a. New 12-1/2 ton unit to be as described in the equipment schedule on the project drawings as well as in the specifications.

- b. New AC-1 and AC-2 safety switches. NEMA 3R Heavy duty, 100A, 240V, 3ph. Square D H323NRB or equal.
  - c. AC-1: contractor may re-use existing circuit breakers and conductors in existing conduit up to the new disconnects. Install new conductors (of the same size) after disconnect.
  - d. Re-locate existing control panel and thermostats.
  - e. Bond new units to existing earth counterpoise using bare 2/0 min conductor.
  - f. Install new unit on existing concrete pad per details on project drawings.
2. New CU-5 and AHU-5:
- a. New 7-1/2 ton split system to be as described in the equipment schedule on the project drawings and in this specification.
  - b. New CU-5 and AHU-5 safety switches as described on DWG-M004.
  - c. Install new conductors in new conduit.
  - d. Connect new units to new non-programmable, two stage digital thermostat, Robertshaw RS4220. Thermostat shall have adjustable stage differentials and second stage time delay, with no anti-recycle limit. Wire for continuous power.
  - e. Bond new condensing unit to existing earth counterpoise using bare 2/0 min conductor.
  - f. Install new CU on new concrete pad per details on project drawings.
- 3 New CU-4 and AHU-4:
- a. New 2.5 ton split system air conditioners to be as described in the equipment schedule on the project drawings.
  - b. New safety switches. NEMA 3R Heavy duty.
  - c. Contractor may re-use existing conductors in existing conduit.
  - d. Replace existing circuit breaker in panel ELP-B with 40 amp HACR breaker.
  - e. Provide and connect new thermostat per manufacturers recommendations.
  - f. Bond new CU to existing earth counterpoise using bare 2/0 min conductor.
  - g. Seismically brace new CU with new Unistrut bolted to the CMU block wall similar to existing.
- 4 Grounding: Bond all new or modified ductwork sections to adjacent duct sections (new or existing), and bond final duct section to the air conditioning unit, using #6 copper wire with green insulation and UL approved lug. Bond all conduits used for this project, new or existing, which enter the building from the outside, to the earth counterpoise. Conduits are to be bonded to a new copper bulkhead plate(s) using #2 copper wires and UL approved double lugs. The bulkhead plate is then to be exothermically welded (Cadweld) directly to the counterpoise with a 4/0 bare copper conductor.

A metal bulkhead connector plate shall be provided where conduits first enter the facility. The bulkhead connector plate shall be mounted on the outside surface of the facility, a minimum of 1/4 inch thick, and shall be constructed of tin-plated copper. The plate or plates provide adequate surface area for bonding conduits. Conduits (where not bonded directly to the EES) shall be

bonded to the bulkhead plates with a minimum 4 AWG bonding jumper. Conduits shall be bonded with a UL listed U-Bolt bonding connector. Bonding jumpers shall be connected to the plate with either an exothermic weld or a double-bolted lug and shall be no longer than 12 inches. The bulkhead plate shall be bonded to the EES with a minimum 4/0 AWG copper cable color coded green with a red tracer. When the bulkhead connector plate is located within 6 feet of 40 building steel, the bulkhead plate shall be connected to building steel with a 4/0 AWG copper conductor color coded green with a red tracer. The building structural steel is required to be bonded to the EES. Exothermic welds shall be used for these connections.

### 1-3.1 Construction Sequence

Any required outages must be scheduled at least one week in advance, but should be scheduled as far in advance as possible. All work in electrical distribution panel MDPE shall be done during a scheduled outage. Contractor should plan on finishing all work in Panel MDP in one outage. Planned start time should be 8:00 PM, however, this may vary at the discretion of the FAA.

The contractor shall:

#### Phase 1.

1. Install new CU-5 and AHU-5. Perform start up and testing using a factory authorized representative and provide refrigeration report as described in these specifications. Allow unit to run for 48 hours without incident. If unit fails, the problem shall be corrected and the 48 hour clock shall be re-started.

#### Phase 2:

1. Isolate AC-2 supply and return ductwork in accordance with plans.
2. Replace AC-2, along with supply and return ductwork.
3. Install temporary AC-2 return air duct.
4. Perform start up of unit using factory authorized technician. Provide refrigeration start up report as described in these specifications. Allow unit to run for 48 hours without incident. If unit fails, the problem shall be corrected and the 48 hour clock shall be re-started.

#### Phase 3:

1. Replace AC-1 ductwork and disconnect.

Perform remainder of work, including air balance.

Note: CU-4/AHU-4 may be replaced at any time.

1-4.0 WAGE DETERMINATION DECISIONS: The Contractor must comply with the minimum wage requirements of the Department of Labor wage determination decision for Alameda County, California.

1-5.0 WARRANTY: The Contractor must warrant all materials, equipment and labor for all work performed under this contract. This warranty must be for a period of one calendar year beginning upon the date of contract acceptance inspection (CAI). The warranty must be unconditional and the Contractor must furnish all labor and materials required to repair or replace defective or failed portions of the contract work. Warranty repair work must be performed in the same manner as new work in accordance with the technical requirements of this specification. Any warranty repairs must be completed by the Contractor within a maximum of 48 hours after notification by the Government for any failure which causes a mechanical system to be inoperative. Other failures or defects which have no operational impact to the facility must be corrected within a maximum of 15 calendar days after notification by the Government. The specific items of work performed under warranty must then themselves be unconditionally warranted for a period of one calendar year beginning upon the date of completion of the repair work.

In addition to the above unconditional warranty, the refrigerant compressors must be guaranteed by the air conditioning unit manufacturer for an additional four years beginning one calendar year after the date of CAI. This additional manufacturer's four year guarantee must include furnishing new replacement compressors, but does not include labor and materials required to replace the compressors. The Contractor must furnish to the R.E. the manufacturer's certificate of this warranty stating the beginning and ending dates of the period of coverage. Also, guarantee that each piece of apparatus must have a capacity or performance of not less than that specified or indicated on drawings, when the apparatus is operating under specified design conditions.

1-6.0 SUBMITTALS: Within seven (7) calendar days after the date of contract award, the Contractor must submit to the RE a list of all materials and equipment to be used under this contract. This list must include a brief description of the materials or equipment, the name of the manufacturer, and the model or type number.

The use of brand name with, or without, an or approved equal statement following the purchase description in this specification or on the project drawings is intended to promote competition by encouraging the offering of products that are equal in all material respects to the brand name products cited in such descriptions. The reference by brand name does not indicate a preference for the products mentioned but identifies a product known to furnish the quality and characteristics that meet the requirements of this specification. All characteristics of a specified brand name product which are essential to the Government are described in this specification or on the project drawings. The Contractor must obtain product literature from the manufacturer of the specified brand name product to determine its general quality and functional characteristics and must use that information in making any desired substitutions.

Where the Contractor elects to use the manufacturer and model number specified herein, no further technical information or shop drawings need to be submitted. Where the Contractor desires to utilize the products of another manufacturer or where no make or model is specified, a complete set of shop drawings and descriptive literature must be submitted, including selected performance data, electrical data including MCA and any required changes to electrical sizing or

requirements, internal controls diagrams and external control connection diagrams, clearance requirements, and any other information required to determine whether the new equipment will meet the FAA's requirements. Any new work required as a result of acceptance of materials by another manufacturer will be the responsibility of the contractor, and no additional compensation will be made. Contractor must submit three (3) copies of descriptive literature, shop drawings, and/or samples to the RE for approval for any item he wishes to submit as equal to the brand name(s) as specified.

Information must be submitted within fourteen (14) calendar days after the date of contract award and must include, but not be limited to the following, where applicable:

- (1) Air conditioning equipment including air handling units, condensing units, etc.
- (2) Ductwork and accessories
- (3) Insulation
- (4) Controls
- (5) Electrical equipment
- (6) Piping and accessories
- (7) Construction Schedule

Shop drawings must include manufacturer's catalog data and certified capacity data. Information submitted must be complete to enable the item to be evaluated from an engineering viewpoint and must be sufficient to show compliance with this specification.

The project drawings are designed for the particular manufacturer and model specified. However, where required to show specific details of equipment interface, attachment, support, wiring, etc., the Contractor must provide any additional shop drawings or descriptive literature for any equipment, including that specified, as required by the RE.

The Contractor must carefully select equipment and materials, furnish shop drawings and other documentation required above, place and confirm orders for equipment and materials, and schedule all delivery dates in a manner which conforms with the performance time and advance acquisition time allotted by this contract.

Notice-To-Proceed with on-site work will not be granted until the Contractor certifies to the Contracting Officer that all required materials and equipment, as approved by the Government, are in his possession and ready for installation.

**1-7.0 PERFORMANCE TIME:** The Contractor must be required to commence work under this contract within one day after the date of Notice-To-Proceed, prosecute the work diligently and complete the entire work ready for use no later than 60 calendar days after the date of Notice-To-Proceed.

Prior to the effective date of the Notice-To-Proceed with on-site work, a maximum of 60 calendar days lead time after the date of Contract Award will be allowed to obtain the required

materials and equipment. All shop drawing submissions must also be accomplished during this lead time. The time required from submission of shop drawings to approval by the Government will not be included in the above specified lead time. Notice-To-Proceed with on-site work will not be granted until the Contractor certifies to the Contracting Officer that all required materials and equipment, as approved by the Government, are in his possession and ready for installation. The Contracting Officer will coordinate the Notice-To-Proceed date with the Contractor to ensure his ability to commence work upon that date.

1-9.0 WORK SCHEDULE: All work must be scheduled and performed between the hours of 7:00 AM to 5:00 PM except for scheduled outages or when prior approval has been obtained from the Resident Engineer. Outages will take place at night, sometime between 8PM and 6AM (exact time will depend on availability as determined by the FAA). Alternate work schedules such as 10 hours per day for 4 days per week are acceptable subject to the total work time per week must not exceed 40 hours. All work schedules proposing more than 8 hours of work per day must be approved in advance by the Resident Engineer. No work shall be scheduled or performed on Saturdays, Sundays or federal holidays, or during holiday maintenance moratorium periods, unless approved in advance. Maintenance moratorium periods usually occur for approximately 10 days around Thanksgiving and for approximately two weeks around Christmas. Exact dates are not known at this time.

1-10.0 AVAILABILITY OF UTILITIES: Electricity is available for the Contractor's use, with the exception that during any facility outages (see Work Schedule), there will be no electricity available at the facility. The Contractor will be responsible for providing portable generators as necessary to provide for his electrical requirements during outages. The Contractor shall also provide temporary lighting for work areas during outages.

Water is not available at the facility. The contractor will need to transport and provide any water required for project.

A portable toilet is available at the site for the Contractor's use. The portable toilet shall be maintained by the Contractor and be clean and sanitary at all times.

Public telephone service is not available for the Contractor's use at the project location. It is suggested that the Contractor furnish his personnel with electronic paging equipment, cellular telephones or make other arrangements to maintain communications. The Government will not be responsible for receiving telephone calls, taking messages or contacting Contractor personnel to deliver messages.

Trash removal shall be the Contractor's responsibility. Furnish appropriate waste receptacles and service to pickup and transport all waste material to an approved commercial dump or waste processing facility.

1-11.0 PRECONSTRUCTION CONFERENCE: A preconstruction conference may be held at the construction site or at the SSC office between the representatives of the Government and the Contractor prior to the start of work.

1-12.0 SECURITY REQUIREMENTS: The Contractor must comply with all security requirements of the facility. This facility is on a live airport runway. The contractor must be escorted at all times.

1-13.0 GOVERNMENT FURNISHED MATERIALS (GFM): None

1-14.0 LIST OF PROJECT DRAWINGS:

Construction Drawings	<u>Title</u>
QMV-D-ASR-D001	DEMOLITION
QMV-D-ASR-D002	DEMOLITION
QMV-D-ASR-M001	EQUIPMENT SCHEDULES
QMV-D-ASR-M002	PLAN
QMV-D-ASR-M003	DETAILS AND SECTIONS
QMV-D-ASR-M004	DETAILS AND SECTIONS 2

Reference Drawings:

OAKLAND ASR  
OAKLAND, CALIFORNIA

AIR CONDITIONING REPLACEMENT PROJECT

DIVISION 2  
SMALL PROJECT CONSTRUCTION SPECIFICATIONS

**2-1.0 SCOPE:** The Contractor must furnish and install air conditioning units, fan-coil units, condensing units, ductwork and accessories, concrete pads, piping, controls, and electrical work as specified herein. The air conditioning systems specified herein or shown on the drawings must be complete, functional, and operational in all respects.

**2-2.0 CODES AND STANDARDS:** All labor and material must be in strict conformance with the rules and regulations of the Air Conditioning and Refrigeration Institute (ARI), National Fire Protection Association (NFPA), American Society for Testing and Materials (ASTM), and American Society of Mechanical Engineers (ASME), where such standards have been established for the particular item of equipment used.

All equipment and materials must be installed in accordance with the manufacturer's instructions. A copy of the manufacturer's installation instructions must be maintained on site and made available to the Resident Engineer (R.E.) before any equipment is installed or any work with that material begins.

**2-3.0 APPLICABLE DOCUMENTS:** The following standard publications, of the issues currently in force, form a part of this specification. The Contractor must perform all work not included in this specification in accordance with these publications:

International Code Council	International Mechanical Code 2009 Edition
International Code Council	International Plumbing Code 2009 Edition
Sheet Metal and Air Conditioning Contractors National Association (SMACNA)	HVAC Duct Construction Standards, Metal and Flexible 1997 Edition
National Fire Protection Association	National Electrical Code, 2011 Edition
(Manufacturer of Installed Equipment)	Equipment Installation Instructions,

Applicable Edition for  
Specified or Approved  
Model Number

**2-4.1 Sheet Metal Ductwork:** Sheet metal ductwork shall be constructed of galvanized steel sheets. Ducts shall conform to the dimensions indicated and shall be straight and smooth on the inside, with joints neatly finished. Duct transverse joints shall be by a bolted preformed angle with integral gasket and sealant configured to give maximum rigidity to the joint with an airtight seal. Transverse joints shall be Ductmate 25 or 35, or approved equal, with the type and installation in accordance with the manufacturer's instructions. Longitudinal seams shall be "Pittsburgh lock" construction. All edges and slips shall be hammered down to leave a smooth interior duct finish. All seams and joints in duct system, other than transverse joints with integral seal, and all joints where ducts pass through building walls shall be sealed to withstand a pressure of plus or minus 4" of water gage and finished to a smooth surface and made completely airtight. Apply sealant in accordance with manufacturer's recommendations. Sealant shall be Rectorseal Air-Lock 181, or approved equal. All sealants shall be water based; Petroleum based sealants will not be permitted due to their inherent hazardous vapors. Sealant on exposed duct shall be applied in a manner which results in a smooth surface free of runs, cracks, holes and splatter on adjacent surfaces. Following curing, the adhesive shall be painted with two coats of exterior latex enamel of a color to match the duct. All new or modified existing ductwork shall be painted to match existing duct.

All new ducts and modified portions of existing ducts shall be anchored securely to the framing in the building. Attachments and hangers shall be selected and installed to safely support the load, to prevent sagging of the duct, and to restrain horizontal movement of the duct. Ducts shall be so constructed and installed as to be completely free from vibration under all conditions of operation. Supports shall be attached only to structural framing members or to concrete surfaces with expansion anchors. Where supports are required between structural framing members, RE approved intermediate metal framing shall be provided.

#### **2-4.2 Duct Liner:**

**2-4.2.1 Acoustical Duct Lining:** All supply and return duct shall be provided with acoustical liner. Acoustical duct lining shall be fibrous glass, flexible type, with vapor barrier designed exclusively for lining duct. For service in low-velocity duct systems, the air-side surface of the liner shall be capable of withstanding air velocity of 5,000 feet per minute without delamination or erosion. The surface coating shall be formulated with an anti-microbial agent so it will not support the growth of fungus or bacteria. The material thickness shall be either one (1) inch or as shown on the project drawings, whichever is greater. Thermal conductivity shall be no greater than .25 BTU-Inch per square foot per °F per hour at 75 °F. Liner Noise Reduction Coefficient (NRC) shall be .70 minimum for 1" thick and 1.00 as tested per ASTM C 423 using a Type "A" mounting, and ASTM standard E795. Air friction shall not be more than .09 inches wg/100 feet

of duct at 1500 feet per minute air velocity and 10,000 CFM. The acoustical liner shall conform to the fire hazard classification requirements of the National Fire Protection Association.

The lining shall be applied in cut-to-size pieces attached to the interior of the duct with fire resistant adhesive. Top and bottom pieces shall lap the side pieces and, in addition, shall be secured with welded pins, adhered clips, metal, nylon or high impact plastic, and speed washers or welding cuphead pins on maximum 12 inch centers. Lining shall not be folded at corners or treated in any manner that reduces thickness and impairs insulating properties of material. Liner shall be neatly butted without gaps at transverse joints and shall be coated with adhesive at such joints. All exposed edges of liner shall be coated with lagging adhesive to prevent delamination.

Lagging adhesive shall be Foster Sealfas 30-36, or approved equal. Duct liner shall be Johns-Manville "Permacote Linacoustic HD", or approved equal.

**2-4.3 Turning Vanes:** Turning vanes shall be provided in all supply and return air duct square and rectangular elbows. Vanes shall be of the small, curved, double-walled type for uniform air distribution and change of direction with minimum turbulence and pressure loss. Air shall leave turning vanes parallel to sidewalls of the duct. Turning vanes shall be constructed per SMACNA Figure 2-3.

**2-4.4 Flexible Duct Connection:** Where sheet metal connections are made to equipment, a flexible connection of 22-ounce per square yard oil and acid resistant, noncombustible material approximately 3 inches in width shall be installed. Flexible connections shall be securely fastened and locked to 24 gauge metal collars using normal duct construction methods. Flexible duct connections shall be installed to provide not less than 2 inch clear space between metal parts being connected and shall be free of tension permitting movement at either side without transmitting movement to the other side. Flexible connectors shall be Duro-Dyne "Metal-Fab" or "Super Metal-Fab" (6" fabric) with Durolon fabric, or equal.

All flexible connectors installed on equipment located outdoors shall be weather protected with a 22 gage sheetmetal cover secured to the equipment cabinet and configured to shade the connector fabric on the top and both sides of the duct. Cover shall not restrict the duct or equipment movement in any direction.

**2-5.0 AIR CONDITIONING EQUIPMENT:** Equipment make and model and all performance data must be in accordance with the data table on the project drawings. The minimum/maximum performance data specified must not be below the minimum nor above the maximum by more than 5% of the specified value.

**2-5.1 Split System Air Conditioner:** The system major components including condensing unit, refrigeration flow controls, and evaporator coil must be all sized, selected, and assembled by one equipment manufacturer. That manufacturer must provide certified performance data for the total system to show compliance with the data table on the project drawings.

#### **2-5.1.1 CU-5 and AH-5**

### **2-5.1.1.2 Condensing Units**

#### **Part 1 — General**

##### **1.01 SYSTEM DESCRIPTION**

Outdoor-mounted, air-cooled condensing unit suitable for on-the-ground or rooftop installation. Unit shall consist of a hermetic scroll air-conditioning compressor(s) assembly, an air-cooled coil, propeller-type condenser fans, and a control box. Unit shall discharge supply air upward as shown on contract drawings. Unit shall be used in a refrigeration circuit matched with a packaged air-handling unit.

##### **1.02 QUALITY ASSURANCE**

- A. Unit shall be rated in accordance with AHRI Standard 360.
- B. Unit construction shall comply with ANSI/ASHRAE 15 safety code latest revision and comply with NEC.
- C. Unit shall be constructed in accordance with UL 1995 standard and shall carry the UL and UL, Canada label.
- D. Unit cabinet shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- E. Air-cooled condenser coils for hermetic scroll compressor units (38AUZ) and 38AUD shall be leak tested at 150 psig, and pressure tested at 650 psig.
- F. Unit shall be manufactured in a facility registered to ISO 9001:2000 manufacturing quality standard.

##### **1.03 DELIVERY, STORAGE, AND HANDLING**

Unit shall be shipped as single package only, and shall be stored and handled according to unit manufacturer's recommendations.

#### **Part 2 — Products**

##### **2.01 EQUIPMENT**

###### **A. General:**

Factory-assembled, single piece, air-cooled condensing unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge, and special features required prior to field start-up.

###### **B. Unit Cabinet:**

- 1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a prepainted baked enamel finish.
- 2. A heavy-gauge roll-formed perimeter base rail with forklift slots and lifting holes shall be provided to facilitate rigging.

###### **C. Condenser Fans:**

- 1. Condenser fans shall be direct driven, propeller type, discharging air vertically upward.

2. Fan blades shall be balanced.
3. Condenser fan discharge openings shall be equipped with PVC-coated steel wire safety guards.
4. Condenser fan and motor shaft shall be corrosion resistant.

#### D. Compressor:

1. Compressor shall be of the hermetic scroll type .
2. Compressor shall be mounted on rubber grommets.
3. Compressors shall include overload protection.
4. Compressors shall be equipped with a crankcase heater.
5. Compressor shall be equipped with internal high pressure and high temperature protection.
6. 38AUZ\*16 and 25 sizes shall use two scroll compressors manifold together.

#### E. Condenser Coil:

1. Condenser coil shall be air-cooled and circuited for integral sub--cooler.
2. Standard condenser coils for all models, except 25 size, shall have all aluminum NOVATIONt Heat Exchanger Technology design consisting of aluminum multi--port flat tube design and aluminum fin. Coils shall be a furnace brazed design and contain epoxy lined shrink wrap on all aluminum to copper connections. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 199 burst test at 1980 psig. 38AUZ\*25 shall be constructed of aluminum fins (copper fins optional) mechanically bonded to internal grooved seamless copper tubes which are then cleaned, dehydrated, and sealed.

#### F. Refrigeration Components:

Refrigeration circuit components shall include liquid line service valve, suction line service valve, a full charge of compressor oil, and a partial holding charge of refrigerant.

#### G. Controls and Safeties:

1. Minimum control functions shall include:
  - a. Control wire terminal blocks.
  - b. Compressor lockout on auto-reset safety until reset from thermostat.
  - c. Each unit shall utilize the Comfort Alertt Diagnostic Board that provides:
    - (1.) System Pressure Trip fault code indication
    - (2.) Short Cycling fault code indication
    - (3.) Locked Rotor fault code indication
    - (4.) Open Circuit fault code indication
    - (5.) Reverse Phase 3 fault code indication
    - (6.) Welded Contactor fault code indication
    - (7.) Low Voltage fault code indication
    - (8.) Anti--short cycle protection
    - (9.) Phase reversal protection
2. Minimum safety devices which are equipped with automatic reset (after resetting first at thermostat), shall include:
  - a. High discharge pressure cutout.
  - b. Low pressure cutout.

#### I. Electrical Requirements:

1. Unit electrical power shall be single-point connection.
2. Unit control circuit shall contain a 24-v transformer for unit control.

J. Special Features:

1. Low-Ambient Temperature Control:

Low-ambient control shall regulate speed of the condenser-fan motors in response to the saturated condensing temperature of the unit. The control shall maintain correct condensing pressure at outdoor temperatures down to 0 deg F .

2. Louvered hail Guard Package:

Louvered hail guard package shall protect coils against damage from hail and other flying debris.

### **2-5.1.1.3 Air Handlers:**

#### Part 1—GENERAL

##### SYSTEM DESCRIPTION

- A. Indoor, packaged air-handling unit for use in commercial split systems. Unit shall have a multi--position design and shall be capable of horizontal or vertical installation on a floor or in a ceiling, with or without ductwork. (Only vertical units are to be applied without ductwork.)
- B. Unit with direct-expansion coil shall be used in a refrigerant circuit with a matching air-cooled condensing unit. Unit with chilled water coil shall be used in a chilled water circuit.

##### QUALITY ASSURANCE

- A. Coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration (U.S.A.), latest edition.
- B. Unit shall be constructed in accordance with ETL (U.S.A.) and ETL, Canada, standards and shall carry the ETL and ETL, Canada, labels.
- C. Unit insulation and adhesive shall comply with NFPA-90A (U.S.A.) requirements for flame spread and smoke generation. Insulation shall contain an EPA-registered immobilized antimicrobial agent to effectively resist the growth of bacteria and fungi as proven by tests in accordance with ASTM standards G21 and 22 (U.S.A.).
- D. Unit shall be manufactured in a facility registered to the ISO 9001:2000 manufacturing quality standard.
- E. Direct-expansion and chilled water coils shall be burst and leak tested at 435 psi (2999 kPa).

##### DELIVERY AND STORAGE

Units shall be stored and handled per manufacturer's recommendations.

#### Part 2—PRODUCTS

##### EQUIPMENT

Indoor mounted, draw-thru, packaged air-handling unit that can be used in a suspended horizontal configuration or a vertical configuration. Unit shall consist of forward-curved belt-driven centrifugal fan(s), motor and drive assembly, pre--wired fan motor contactor, factory-

installed refrigerant metering devices (direct-expansion coil units), cooling coil, 2-in. (51-mm) disposable air filters, and condensate drain pans for vertical or horizontal configurations.

#### A. Base Unit:

1. Cabinet shall be constructed of mill-galvanized steel.
  2. Cabinet panels shall be fully insulated with 1/2-in. (12.7-mm) fire-retardant material. Insulation shall contain an EPA-registered immobilized antimicrobial agent to effectively resist the growth of bacteria and fungi as proven by tests in accordance with ASTM standards G21 and 22 (U.S.A.).
  3. Unit shall contain non-corroding condensate drain pans for both vertical and horizontal applications. Drain pans shall have connections on right and left sides of unit to facilitate field connection. Drain pans shall have the ability to be sloped toward the right or left side of the unit to prevent standing water from accumulating in pans.
  4. Unit shall have factory-supplied 2-in. (51 mm) throwaway-type filters installed upstream from the cooling coil.
- Filter access shall be from either the right or left side of the unit.

#### B. Coils:

DX coil is 4--row and consists of copper tubes with sine-wave aluminum fins bonded to the tubes by mechanical expansion. Suction and liquid line connections or supply and discharge connections shall be made on the same side of the coil.

1. Direct-expansion coils shall feature factory installed thermostatic expansion valves (TXVs) for refrigerant control. The TXVs shall be Puron R--410A compatible and capable of external adjustment. Direct-expansion heat pump coils shall have a factory-installed bypass line and check valve assembly around the TXVs to allow liquid flow from the coil to the outdoor unit during the heating mode. Coil tubing shall be internally rifled to maximize heat transfer.

#### C. Operating Characteristics:

Unit shall be capable of providing cfm (L/s) airflow at an external static pressure of in. wg (kPag).

#### D. Motor:

1. Fan motor of the size and electrical characteristics specified on the equipment schedule shall be factory supplied and installed.
2. Motors rated at 1.3 through 3.7 hp (0.97 through 2.76 kW) shall have internal thermal overload protection. Motors rated at 5 hp (3.73 kW) shall be protected by a circuit breaker.
3. Evaporator-fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers. Evaporator motors are designed specifically for Carrier and do not have conventional horsepower (hp) ratings listed on the motor nameplate. Motors are designed and qualified in the "air-over" location downstream of the cooling coil and carry a maximum continuous bhp rating that is the maximum application bhp rating for the motor; no "safety factors" above that rating may be applied.

4. All evaporator-fan motors 5 hp and larger shall meet the minimum efficiency requirements as established by the Energy Policy Act of 1992 (EPACT), effective October 24, 1997.

1. Return-Air Grille:

Grille shall be factory-supplied for field installation on the unit's return air opening.

2. Overhead Suspension Package:

Package shall include necessary brackets to support units in a horizontal ceiling installation.

### **2-5.1.2 CU-4 and AH-4**

#### **Part 1 – General**

##### **1.1 System Description**

The system shall consist of a horizontal discharge, single phase outdoor unit, a matched capacity indoor section that shall be equipped with a wired wall mounted controller.

##### **Quality Assurance**

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and local codes as required.
- C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the ARI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- E. A dry air holding charge shall be provided in the indoor section.
- F. The outdoor unit shall be pre-charged with R-410a refrigerant for 100 feet (30 meters) of refrigerant tubing

##### **1.01 Delivery, Storage and Handling**

- A. Unit shall be stored and handled according to the manufacturer's recommendations.
- B. The controller shall be shipped inside the carton with the indoor unit and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

#### **Part 2 – Warranty**

**2.01** The units shall have a manufacturer's parts and defects warranty for a period five (5) year from date of installation. The compressor shall have a warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

#### **Part 3 Outdoor Unit Design:**

3.04 The outdoor unit shall be capable of operating at 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle shall be required).

**3.07** The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

### 3.2 Cabinet

3.2.1 The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a Munsell 3Y 7.8/1.1 finish.

3.2.2 Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability.

3.2.3 Easy access shall be afforded to all serviceable parts by means of removable panel sections.

3.2.4 The fan grill shall be of ABS plastic.

3.2.5 Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

### 3.3 Fan

3.3.2 The fan blade(s) shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated.

3.3.3 The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts

### 3.4 Coil

3.4.1 The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard.

3.4.2 Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor controlled step motor.

### 3.5 Compressor

3.5.1 The compressor for model shall be a Frame Compliant Scroll compressor with Variable Speed Inverter Drive Technology.

3.5.2 The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings.

3.5.3 To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used. No crankcase heater is to be used.

3.5.4 The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

### 3.6 Electrical

3.6.1 The electrical power of the unit shall be 208volts or 230 volts, single phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.

3.6.2 Power for the indoor unit shall be supplied from the outdoor unit via Mitsubishi Electric A-Control using three (3) fourteen (14) gauge AWG conductors plus ground wire connecting the units.

3.6.3 The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.

## Part 4 - Indoor Unit

### 4.1 Ceiling Suspended Type

The Ceiling Suspended type indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor.

The unit, in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch.

4.1.1 Unit Cabinet: The casing shall be ABS plastic and have a Munsell 6.4Y 8.9/0.4 white finish. Cabinet shall be designed for suspension mounting from above and horizontal operation. Indoor unit shall have removable mounting brackets. A mounting template with suspension bolt locations shall be furnished with indoor unit. Mounting bolts or threaded rod of 3/8" diameter shall be used to suspend unit and unit shall not require direct contact with ceiling or panel for proper operation. Mounting support shall be of sufficient strength and design to support full weight of indoor unit. The rear cabinet panel shall have knock-out provisions for a field installed filtered 4-5/16 diameter ventilation air intake connection.

4.1.2 Fan: The indoor unit fan shall have multiple high performance, double inlet, forward curve sirocco fans driven by a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of four (4) speeds: Low, M1, M2, and Hi plus AUTO fan setting. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and sensed space temperature.

4.1.3 Vane: There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five (5) vertical airflow patterns selected by remote control: 100% horizontal flow, 80% horizontal flow (plus 20% downward airflow), 60% horizontal airflow (plus 40% downward airflow), 40% horizontal airflow (plus 60% downward airflow), and swing. The horizontal vane shall significantly decrease downward air resistance for lower sound levels, and shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.

Filter Return air shall be filtered by means of an easily removable washable filter

4.1.4 Coil The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. . .

4.1.5 Electrical: The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The power to the indoor unit shall be supplied from the outdoor unit. A three (3) conductor AWG-14 wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. A disconnect shall be mounted near the indoor unit, a 3-Pole Disconnect shall be used (TAZ-MS303 or equal) – all three conductors must be interrupted.

4.1.8 System Control: The control system shall consist of a minimum of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit. The control voltage from the wired controller to the indoor unit shall be 12/24 volts, DC.

The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.

The system shall be capable of automatic restart when power is restored after power interruption.

The system shall have self-diagnostics ability, including total hours of compressor run time.

Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

The indoor unit shall be connected to a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large DOT liquid crystal display (LCD) The controller shall have a built-in temperature sensor. Temperature shall be displayed in Fahrenheit (°F) Temperature changes shall be by increments of 1°F (1°C) with a range of 67°F to 87°F (19°C to 30°C).

The wired controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat. Normal operation of the wired controller shall provide individual system control in which one wired controller and one indoor unit are installed in the same room.

### **2-5.2 SINGLE PACKAGED COOLING ONLY AIR CONDITIONERS:**

The system major components including the condenser coil, evaporator coil, blower, economizer, refrigerant piping and controls shall be assembled by one manufacturer and shall be rated as a system by the American Refrigeration Institute (ARI) with respect to capacity and energy efficiencies. The manufacturer shall provide certified performance data for the air conditioner to show compliance with the data table on the project drawings.

#### **2-5.2.1 AC-2**

##### HVAC Equipment Insulation

##### Evaporator fan compartment:

1. Interior cabinet surfaces shall be insulated with a minimum 1/2--in. thick, minimum 1 1/2 lb density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

##### Electric and Electronic Control System for HVAC

##### General:

1. Shall be complete with self--contained low--voltage control circuit protected by a resettable circuit breaker on the 24--v transformer side. Transformer shall have 75VA capability.
2. Shall utilize color--coded wiring.
3. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, economizer, thermostat, DDC control options, and low and high pressure switches.
4. Unit shall include a minimum of one 8--pin screw terminal connection board for connection of control wiring.

##### 23 09 33.23.B. Safeties:

1. Compressor over--temperature, over current.
2. Low pressure switch.
  - a. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross--wiring of the safety switches between circuits 1 and 2.
  - b. Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
3. High pressure switch.
  - a. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross--wiring of the safety switches between circuits 1 and 2.
  - b. High pressure switch shall use different color wire than the low pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
4. Automatic reset, motor thermal overload protector.

### Self--Contained Air Conditioners

1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a(n) hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
2. Factory assembled, single--piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start--up.
3. Unit shall use environmentally safe, R-410a or Puron refrigerant.
4. Unit shall be installed in accordance with the manufacturer's instructions.
5. Unit must be selected and installed in compliance with local, state, and federal codes.

### Quality Assurance

1. Unit meets ASHRAE 90.1 minimum efficiency requirements.
2. Unit shall be rated in accordance with AHRI Standards 210/240 and 340/360.
3. Unit shall be designed to conform to ASHRAE 15, 2001.
4. Unit shall be UL--tested and certified in accordance with ANSI Z21.47 Standards and UL--listed and certified under Canadian standards as a total package for safety requirements.
5. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
6. Unit casing shall be capable of withstanding 500--hour salt spray exposure per ASTM B117 (scribed specimen).
7. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000--hour salt spray.
8. Unit shall be designed in accordance with ISO 9001:2000, and shall be manufactured in a facility registered by ISO 9001:2000.
9. Roof curb shall be designed to conform to NRCA Standards.
10. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
11. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
12. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
13. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
14. High Efficient Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).

### Delivery, Storage, and Handling

1. Unit shall be stored and handled per manufacturer's recommendations.
2. Lifted by crane requires either shipping top panel or spreader bars.
3. Unit shall only be stored or positioned in the upright position.

### Operating Characteristics

1. Unit shall be capable of starting and running at 115\_F (46\_C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at  $\pm 10\%$  voltage.
2. Compressor with standard controls shall be capable of operation down to 40\_F (4\_C) , ambient outdoor temperatures.  
Accessory winter start kit is necessary if mechanically cooling at ambient temperatures down to 25\_F (-4\_C).
3. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.
4. Unit shall be factory configured for vertical supply & return configurations.
5. Unit shall be field convertible from vertical to horizontal airflow on all models. No special kit required on 04—14 models. Supply duct kit required for 16 size model only.
6. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

#### Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre--painted baked enamel finish on all externally exposed surfaces.
2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60\_F):  
60, Hardness: H--2H Pencil hardness.
3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 210/240 or 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2--in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil--faced fiberglass insulation shall be used in the heat compartment.
4. Base of unit shall have a minimum of four locations for thru--the--base gas and electrical connections (factory installed or field installed), standard.
5. Base Rail
  - a. Unit shall have base rails on a minimum of 2 sides.
  - b. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
  - c. Holes shall be provided in the base rail for moving the rooftop by fork truck.
  - d. Base rail shall be a minimum of 16 gauge thickness.
6. Condensate pan and connections:
  - a. Shall be a sloped condensate drain pan made of a non--corrosive material.
  - b. Shall comply with ASHRAE Standard 62.
  - c. Shall use a 3/4" --14 NPT drain connection, possible either through the bottom or end of the drain pan. Connection shall be made per manufacturer's recommendations.
7. Top panel:
  - a. Shall be a single piece top panel on 04 thru 12 sizes, two piece on 14 and 16 size.
8. Electrical Connections
  - a. All unit power wiring shall enter unit cabinet at a single, factory--prepared, knockout location.
9. Component access panels (standard)
  - a. Cabinet panels shall be easily removable for servicing.
  - b. Unit shall have one factory installed, tool--less, removable, filter access panel.

- c. Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have molded composite handles.
- d. Handles shall be UV modified, composite, permanently attached, and recessed into the panel.
- e. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
- f. Collars shall be removable and easily replaceable using manufacturer recommended parts.

#### Coils

##### 1. Standard Aluminum fin -- Copper Tube Coils:

- a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
- b. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
- c. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

##### 5. Standard All Aluminum Novation Coils:

- a. Standard condenser coils shall have all aluminum Novation Heat Exchanger Technology design consisting of aluminum multi port flat tube design and aluminum fin. Coils shall be a furnace brazed design and contain epoxy lined shrink wrap on all aluminum to copper connections.
- b. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

#### Refrigerant Components

##### 1. Refrigerant circuit shall include the following control, safety, and maintenance features:

- a. Fixed orifice metering system shall prevent mal--distribution of two--phase refrigerant by including multiple fixed orifice devices in each refrigeration circuit. Each orifice is to be optimized to the coil circuit it serves.
  - b. Refrigerant filter drier.
  - c. Service gauge connections on suction and discharge lines.
  - d. Pressure gauge access through a specially designed access port in the top panel of the unit.
2. There shall be gauge line access port in the skin of the rooftop, covered by a black, removable plug.
- a. The plug shall be easy to remove and replace.
  - b. When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
  - c. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
  - d. The plug shall be made of a leak proof, UV--resistant, composite material.

##### 3. Compressors

- a. Unit shall use one fully hermetic, scroll compressor for each independent refrigeration circuit.
- b. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
- c. Compressors shall be internally protected from high discharge temperature conditions.
- d. Compressors shall be protected from an over--temperature and over--amperage conditions by an internal, motor overload device.

- e. Compressor shall be factory mounted on rubber grommets.
- f. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
- g. Crankcase heaters shall not be required for normal operating range, unless provided by compressor manufacturer due to refrigerant charge limits.

#### Filter Section

- 1. Filters access is specified in the unit cabinet section of this specification.
- 2. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
- 3. Shall consist of factory--installed, low velocity, throw--away 2--in. thick fiberglass filters.
- 4. Filters shall be standard, commercially available sizes.
- 5. Only one size filter per unit is allowed.

#### Evaporator Fan and Motor

- 1. Evaporator fan motor:
  - a. Shall have permanently lubricated bearings.
  - b. Shall have inherent automatic--reset thermal overload protection or circuit breaker.
  - c. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.
- 2. Belt--driven Evaporator Fan:
  - a. Belt drive shall include an adjustable pitch motor pulley.
  - b. Shall use sealed, permanently lubricated ball--bearing type.
  - c. Blower fan shall be double--inlet type with forward--curved blades.
  - d. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

#### Condenser Fans and Motors

- 1. Condenser fan motors:
  - a. Shall be a totally enclosed motor.
  - b. Shall use permanently lubricated bearings.
  - c. Shall have inherent thermal overload protection with an automatic reset feature.
  - d. Shall use a shaft--down design on 04 to 12 models and shaft--up design on 14 size with rain shield.
- 2. Condenser Fans:
  - a. Shall be a direct--driven propeller type fan.
  - b. Shall have aluminum blades riveted to corrosion--resistant steel spiders and shall be dynamically balanced.

#### Special Features, Options and Accessories

- 1. Head Pressure Control Package
  - a. Controller shall control coil head pressure by condenser--fan speed modulation or condenser--fan cycling and wind baffles.
  - b. Shall consist of solid--state control and condenser--coil temperature sensor to maintain condensing temperature between 90 deg F and 110 deg F at outdoor ambient temperatures down to 0 deg F.
- 2. Condenser Coil Hail Guard Assembly

- a. Shall protect against damage from hail.
- b. Shall be louvered design.

### 3. Roof Curbs (Vertical):

- a. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
- b. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
- c. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.

### 4. Winter start kit

- a. Shall contain a bypass device around the low pressure switch.
- b. Shall be required when mechanical cooling is required down to 25°F.

## **2-5.3 CORROSION PROTECTION:**

Condenser coils for ACU-2 and CU-5 shall be corrosion protected by the application of Blygold PoluAl XT as manufactured by Blygold America.

### Coil requirements

Polyurethane coating impregnated with metallic pigment to prevent loss of heat conductivity. Coil / heat exchanger fins shall be of an aluminum construction with a protective coating applied after construction of the coil to achieve a total coverage. The coating shall not block the possible fin perforations. Coating shall be repairable and maintainable on site.

### Coating characteristics:

Coating shall be UV resistant, flexible, heat conductive, chemical resistant to most (aggressive) environments. A resistance list must be available

### Application:

Corrosion protection shall be installed by a factory certified applicator in accordance with factory specifications. The entire unit shall be prepared in order to obtain access to the finned coils. Wiring and sensitive electrical components shall be protected during the cleaning and coating process. Protection against corrosion shall be achieved by means of a high pressure spray technique that ensures full penetration but prevents bridging (thus preventing capacity loss). Copper elbows (returns), headers and brazing parts shall be pretreated with special Polyurethane primer to ensure maximal adhesion and protection to these areas.

### Quality level

Quality level of the treatment should meet the following requirements.

- Appearance Level

The penetration of the coil has to be 100%, to be established and proven by the working method and visual inspection.

- Adhesion Level

The adhesion level should meet Cross hatch test level 0 (European) and 5B (USA) according to ASTM 3359-83 53151 method B-A

- Thickness Level

The thickness level should meet 1 mil (25 µm) plus or minus 20 %.

- Corrosion Resistance Level:

ASTM-B117 (DIN 53167) 4000 hours

Conditions:

- Salt concentration 5 % NaCl
- pH 6,5 - 7,2
- Temperature 37°C (98,5°F)

ASTM-B287 (DIN 50021) 4000 hours

Conditions :

- Salt concentration 5 % NaCl
- pH 3,2 by Acetic Acid (HAc)
- Temperature 37°C (98,5°F)

**2-5.3.1 Coating Documentation:** The coating applicator shall furnish written documentation certifying the name of the applicator, the coating materials applied and the process used to apply them. The documentation shall also state the length and conditions of the applicator's limited warranty.

**2-6.0 PIPING:** The Contractor must check all dimensions and must establish all lines and levels affecting piping and other work specified herein. Such lines, grades, and levels must be checked with the work of other trades to assure proper clearance of piping and equipment. The Contractor must be held responsible for correctness of lines, grades, and levels so established and must provide all fittings and accessories required to satisfy field conditions affecting pipe installation.

Pipe must be cut accurately to measurements established at the site by the Contractor and must be worked into place without springing or forcing. Piping must be run parallel with the lines of the building unless otherwise indicated. A clearance of not less than one inch must be kept between pipe, or finished covering, and other work or the different piping services. Branch connections and changes in pipe size must be made with standard pipe fittings. Change in direction must be made with fittings.

Allowance must be made throughout for expansion and contraction of piping. Flexibility must be provided by use of one or more turns to allow piping to spring without straining.

Pipes in exposed locations must be grouped and be neatly aligned. Vertical pipes must be accurately plumbed. Horizontal pipes must be installed parallel to structural members and level or at a uniform slope when a pitch is required. Groups of vertical pipes must be aligned parallel to a wall whenever practicable, otherwise, they must be aligned 90 degrees to a wall. Groups of horizontal pipes must be aligned either horizontally or vertically.

**2-6.1 Pipe Hangers and Supports:** All piping must be supported, anchored, and guided in a manner such that expansion and contraction will take place in the direction desired and vibration and undue strain on equipment will be prevented. Hangers must have means of vertical adjustment after piping is in place. Supports on flat surfaces must be with "Unistrut" P-2558 pipe strap bolted to P-1000 channel, or approved equal. Location of hangers must be coordinated with the structural work to assure that structural members will support the load under operating conditions.

Hangers and clamps applied to bare copper must be electrolytically coated or padded with felt. Hangers applied to piping specified to be insulated must be sized for the outside diameter of the insulation. Furnish a rigid non-compressible urethane or calcium silicate block (Dow Corning Trymer, or approved equal) insulation insert of 1" minimum thickness or of equal thickness to the adjoining insulation, whichever is greater, and 12" maximum length at each hanger. Spacing between supports must be not more than 6 feet for tubing up to 1-1/2 inches in diameter and 10 feet for tubing 2 inches and larger. Also, support at each change of direction. Where concentrated loads, such as valves, flanges, and accessories occur, the above spacing does not apply and each location must be supported.

Where necessary to maintain support spacing, structural members must be bridged to suit hanger locations.

## **2-6.2 Refrigeration Systems:**

**2-6.3 Refrigerant Piping:** Refrigerant piping must be fabricated from Type L, ACR quality hard drawn copper tubing and standard weight wrought copper fittings. Swaged joints must not be used. Ells must be long radius type. Tubing cuts must be made square, using a sharp wheel cutter or fine tooth hacksaw, reamed after cutting to remove burrs. Refrigerant piping having joints to be high temperature brazed must be blown out with dry nitrogen gas and a small amount of this gas must be allowed to flow during and after brazing. The gas must be allowed to flow until the temperature of the tubing is below the oxidation point. Extreme care must be exercised to prevent overheating and subsequent pitting, burning or annealing of the base pipe material. Any joints which show pitting, burning, or other evidence of overheating will be rejected by the Government and must be replaced by the Contractor.

Joints must be made with high strength, silver/copper brazing alloy. Brazing alloy must be composed of 15% silver/80% copper with a liquidus temperature of 1480°F and a tensile strength of 85,000 psi minimum. Brazing alloy must be J.W. Harris "Stay-Silv 15", or approved equal.

Where high brazing temperature is not acceptable such as at valves and other speciality fittings with non-removable parts and where approved by the R.E., join the piping utilizing silver-tin alloy solder with a liquidus temperature of no greater than 535°F to prevent damage to temperature sensitive parts. Tensile strength must be 15,000 psi minimum. Solder must be used only for piping operating at a temperature below 150°F and must not be used for any hot gas lines. Solder must be J.W. Harris "Stay-Brite 8", or approved equal. Following soldering, clean all acid, flux, carbon or other contaminations from the pipe joint.

**2-6.3.1 Refrigerant Pipe High Pressure Leak Testing:** After the installation of refrigerant piping fabricated and installed by the Contractor is complete, the entire refrigerant circuit must be tested by the Contractor in the Resident Engineer's presence to prove it is absolutely tight. (This requirement does not apply to package type air conditioners and other self contained systems which were factory tested by the manufacturer and whose refrigerant circuits were not opened or otherwise modified by the Contractor's activities). All expansion and compressor valves must be open to pressure. The test pressure must be achieved using dry nitrogen to 200 psi and held for a period of 2 hours. If, during that time, the test pressure drops by more than 5 psi, the Contractor must visually test the entire system for leaks including the compressor, coils, refrigerant connections to the controls, valves, and piping joints using liquid soap application (or other product intended for visual leak identification) and visual inspection for bubbles created by leaks. If leaks are found, the test pressure must be relieved, the leak repaired, and the test repeated. To repair a leak, the joint must be taken apart, thoroughly cleaned and remade in the same manner as new work, with nitrogen flowing in the line whenever heat is applied.

**2-6.3.2 Evacuation:** After the refrigerant system has been high pressure leak tested and found to be tight, the test pressure must be relieved. Evacuation of the system must be performed during a period when the ambient air around all components is 60°F or above during at least some part of the evacuation period, unless otherwise approved by the R.E. Evacuation lines must be copper tubing or high vacuum rubber tubing. Service gauge hoses are not satisfactory. The entire system must be evacuated to 500 microns (= 0.02 inches) of mercury absolute. The system must be evacuated from both high and low sides together. An electronic instrument capable of reading down to 10 microns must be used to measure the vacuum. Under no circumstances will a dial type pressure gauge be acceptable for measuring the vacuum. When the desired vacuum has been obtained (500 microns of Hg. absolute), the pump must be shut off and the vacuum maintained for at least two hours.

Any noticeable rise in absolute pressure is probably an indication of a leak which must be located and repaired and the above specified high pressure leak testing procedure repeated. If the absolute pressure is successfully maintained, the vacuum must then be broken with the proper refrigerant to atmospheric pressure or above and the system charged.

**2-6.3.3 Charging:** The refrigerant system must be charged with the specified refrigerant in the amount necessary to clear the sight glass of all bubbles in accordance with the condensing unit manufacturer's instructions. The amount of charge for each system must be determined by weight, recorded and included in the refrigeration startup report as specified below.

**2-6.3.4 Refrigerant Pipe Medium Pressure Leak Testing:** After the system is high pressure leak tested, evacuated and charged as specified above, electronically test for leaks with the compressor(s) and blower(s) off using an electronic refrigerant leak detector. The refrigerant pressure will be at its saturation pressure depending upon the current ambient temperature. The Contractor must test the entire system for leaks including the compressor, evaporator and condenser coils, refrigerant connections to the controls, valves, and piping joints.

If the above test is successful, start the compressor(s) and blower(s) and repeat the above test on the entire high pressure side of the refrigeration system from the hot gas discharge side of the compressor to the inlet side of the expansion valve or capillary tube and all joints and components in between. The refrigerant pressure will be at its highest saturation or superheated pressure depending upon the current condensing temperature.

If leaks are found, the refrigerant must be removed and recovered. To repair a leak, the joint must be taken apart, thoroughly cleaned and remade in the same manner as new work, with nitrogen flowing in the line whenever heat is applied. Following repair, repeat the high pressure testing, evacuation, charging and medium pressure testing sequence specified above.

Document the ambient temperatures and refrigerant pressures measured during the entire testing process and include in the refrigeration startup report as specified below.

**2-6.3.4 Refrigerant Circuit Superheat:** The Contractor must measure, adjust and record the superheat setting on any refrigeration systems with expansion valves. Set the superheat at the values recommended by the condensing unit manufacturer. Document all measurements in the refrigeration startup report as specified below.

**2-7.3 Insulation:** After tests have been successfully completed and pipe surfaces have been cleaned and dried, insulation must be installed on pipe, valves and equipment of all new and modified piping systems.

**2-7.3.1 Cold Surface Insulation:** All refrigerant suction piping must be insulated. These piping systems, both indoor and outdoor, must be covered with a flexible, elastomeric thermal insulation with a minimum nominal wall thickness of 3/4" or as shown on the project drawings. Polyethylene or fiberglass insulations are not acceptable. Maximum thermal conductivity must be .27 BTU-In. per sq. ft.-hour-°F at 75°F mean temperature. Water vapor permeability must not exceed 0.20 perm-inch per ASTM test procedure E96, procedure B. Water absorption must not exceed 5% by weight per ASTM test procedure D1056. Flame spread rating must not exceed 25 and smoke developed rating must not exceed 50 per ASTM test procedure E84. Insulation must be capable of preventing condensation on piping with a surface temperature of 35°F in ambient air temperature of 85°F dry bulb, 70% relative humidity. Pipe insulation must be either unslit for

installation as pipe is being assembled or must have factory longitudinal slit with tape or mastic sealed joint. Field cutting of insulation length to allow installation over installed pipe must not be acceptable. Pipe insulation must be Armstrong AP Armaflex SS, or equal. Sheet and roll insulation must be Armstrong Armaflex II, or equal.

**2-7.3.2 Insulation Installation:** Insulation must be applied on clean dry surface after all tests are completed and must be continuous through walls and equipment openings. Insulation on all cold surfaces where vapor barrier jackets are used must be applied with a continuous, unbroken vapor seal. Piping at supports must rest upon 1" thick rigid insulation inserts as specified above. Metal shield must be applied between hangers or supports and the pipe insulation. Shield must be formed 18 gauge sheet metal to fit rigid insulation insert and must be in two halves.

Fittings at all locations must be insulated with miter-cut pipe insulation, with insulation sheet cut to size or with insulation tape of the same material as straight pipe insulation. All butt joints and seams must be sealed with insulation adhesive. All outdoor insulation must be covered with 0.016 inch thick aluminum with longitudinal Z-joint and secured with 2-inch side locking straps at butt joints. The aluminum must be carefully cut and mitered around elbows and fittings for a smooth jacket which totally conceals all insulation. All indoor insulation exposed to view must be finished with polyvinyl chloride (PVC) insulated fitting covers on all pipe fittings, flanges, valves and pipe terminations. Finish all straight pipe sections with 20 mil thick PVC jacketing. Solvent welding adhesive must be used to permanently seal all the PVC circumferential lap joints and longitudinal overlap joints in the system. Bands, straps or mechanical clamps for securing the PVC insulation jacketing will not be acceptable. Apply adhesive with strict adherence to the manufacturer's application instructions. Fitting covers and straight pipe jacketing must be white in color and be ultra violet resistant. They must also not exceed flame spread 25 and smoke developed 50, as rated by Underwriter's Laboratories. A PVC insulation fitting cover and jacketing brand name known to meet the requirements of this specification is Zeston 2000 PVC, as manufactured by Johns-Manville, Inc.

**2-8.0 CONTROLS:** The Contractor must furnish and install automatic temperature controls as specified herein and as shown on the project drawings. All controls must be electric or electronic. Control device make and model numbers, or approved equal, must be as shown on the diagrams on the project drawings.

Upon completion of the contract work, the Contractor must demonstrate to the RE that all controls are properly calibrated and provide the sequence of operation specified. Provide a minimum of three (3) working days advance notice before this demonstration.

**2-9.0 ELECTRICAL:** Items not shown in detail or covered by detailed specifications must be as set forth in the National Electrical Code.

**2-9.1 Conduit Fittings:** All conduit inside building must be electric metallic tubing (EMT) with compression ring type fittings. All conduit outside building must be rigid steel with threaded fittings. Conduit below ground must be rigid steel with a factory applied plastic coating. All flexible conduit, both inside and outdoors, must be metallic, liquid tight.

All flexible metal conduits shall be provided with an external bonding jumper in addition to the internal equipment grounding conductor. The bonding jumper shall be a 6 AWG green insulated stranded copper conductor. The bonding jumper shall terminate on fittings listed for grounding at each end of the flexible metal conduit.

Conduits must be installed parallel or at right angles to the building. Conduits must be securely supported and fastened in place at intervals of not more than 5 feet and at each change of direction. Support from building structural steel, walls, or other R.E. approved structural components. Fasteners must be conduit hangers or one-hole malleable iron pipe straps with appropriate screws or bolts for the surface material. Conduits must not be supported from metal roof decking. Suspended ceiling support wires must not be used for the support of conduits. Changes in direction must be symmetrical bends or cast-metal fittings. Each conduit entrance to outlet boxes, panel boards, and equipment cabinets must be fitted with a lock nut and insulated throat connector.

**2.9.2 Wire:** All wire must have copper conductors. Size must be American Wire Gauge (AWG) with size for power circuits as shown on the project drawings. Size for all control circuits must be #16 AWG. Power wire #10 AWG and smaller may be stranded or solid; #8 and larger wire, and all control wire, must be stranded. Insulation must be type THW or THWN for power wire and type MTW for control wire and must be color coded as follows:

Single Phase		Three Phase	
120 Volts	208/240 Volts	120/208 or 240 Volts	277/480 Volts
Line-Black	Line 1-Black	Phase A-Black	Phase A-Yellow
Neutral-White	Line 2-Red	Phase B-Red	Phase B-Brown
	Neutral-White	Phase C-Blue	Phase C-Orange
		Neutral-White	Neutral-Gray
All Circuits:			
Ground	Green		
Control	Black with numbered adhesive markers on both ends or multiconductor with unique continuous color coded insulation		

Power wires #8 and smaller must have continuous colored insulation. Wires #6 and larger may utilize continuous colored insulation or colored tape. Where conductors are color coded with tape, they must be half lapped for a minimum length of 3 inches in all junction and pull boxes, accessible raceways, panelboards, outlets, switches and equipment cabinets.

All wire must be continuous; no splices will be permitted unless specified on the project drawings. Where permitted, splices must be accomplished with compression type connectors bonded to the wire with a crimping tool and procedure approved by the connector manufacturer. Wires must not be installed until all conduit and fittings are in place. All wires must be drawn

into conduit simultaneously and with adequate lubricating compound to prevent damage to insulation.

Control wiring installed within control panels must be neatly routed between the control components and must run parallel and perpendicular to the sides of the panel. Wires which run diagonally from component to component will not be acceptable. Wiring must have sufficient slack to prevent tension on the termination connector. Route wires between components in the most direct path possible without overshoots and loopbacks. Wires must be run in open slot wiring duct (Thomas & Betts model 91XXX, or equal with size as required for application.) or bundles of wires must be neatly secured with nylon self-locking cable ties. Terminate all control wires with spade type, crimped terminals; Exception: Devices such as relays and terminal blocks which utilize clamp type terminals must not require crimped terminals on the wire. Wrapping of wires around screw heads must not be acceptable. All wires exiting the control panel must terminate on a screw terminal block with each terminal marked the same as on the control schematic on the project drawings.

**2-9.3 Grounding:** All noncurrent carrying metallic parts of the electrical system must be grounded with an insulated wire sized and installed in accordance with Article 250 of the National Electrical Code. Ground wire must be connected to ground bus in each power panel, to ground lug on receptacles, and to enclosure or frame of major electrical devices such as safety switches, motors, motor starters, terminal cabinets, light fixtures, etc. Connection of wire to these devices must be with a separate machine screw and nut which bonds to a clean, bare metal surface. Self tapping screws are not acceptable for this purpose. Screws which are used for support of the enclosure must not be used for this purpose.

All non-current-carrying metal enclosures such as raceways, cable trays and panel boards shall be electrically continuous. Insulating finishes shall be removed between grounding/bonding areas of mating surfaces or bonding jumpers.

Ferrous conduit (galvanized rigid metal conduit only) shall be equipped with bonding bushings at each end or at each termination inside of a panel board, safety switch, junction box, etc., and the equipment grounding conductor shall be bonded to the bushings with a bonding jumper the same size as the equipment grounding conductor. (ref FAA-STD-019e 4.2.10.5)

All exterior conduits that are installed new, or any re-used existing conduits, that enter the shelter or building shall be bonded to the earth electrode system (EES), or to a bulkhead connector plate that is bonded to the EES, where the conduit first enters the shelter or building. Conduits shall be bonded with a UL listed U-Bolt bonding connector. The bond to the EES, or the bulkhead connector plate, shall be a 2 AWG stranded copper conductor using exothermic welds or UL listed pressure connectors.

The bulkhead connector plate shall be mounted on the outside surface of the facility, a minimum of 1/4 inch thick, and shall be constructed of tin-plated copper. The bulkhead plate shall be bonded to the EES with a minimum 4/0 AWG copper cable, color coded green with a red tracer. When the bulkhead connector plate is located within 6 feet of building steel, the bulkhead plate

shall be connected to building steel with a 4/0 AWG copper conductor color coded green with a red tracer. Exothermic welds shall be used for these connections.

**2-9.4 Safety Switches:** Safety switches must be NEMA rated as heavy duty. Enclosures must be NEMA type 1 in indoor locations and NEMA type 3R in outdoor or damp locations unless shown on the project drawings to be a different type for the specific application. Switches must be of the number of poles, voltage and amperage ratings shown on the project drawings. Furnish fuse clips to receive cartridge type dual element fuses in all poles if fusible switches are required on the project drawings. Switches must be the quick-make, quick-break type with visible blades. Switch handles must be the extended arm type for easy identification of position. Switches which utilize rocker arm type handles or have concealed blades are not acceptable. Switch handles must be capable of being secured in both the on and off positions by use of a Government owned and installed padlock with a 5/16" diameter shackle. The switch cover must also be capable of being secured in the closed position with a separate Government owned and installed padlock with a 5/16" diameter shackle. The Contractor must modify the switch as required to achieve these locking capabilities. The switch must be grounded with a separate lug secured to the enclosure's bare metal with a bolt and nut. The use of the switches' neutral bus with, or without, a grounding electrode screw bonding to the enclosure is not a satisfactory enclosure ground. A brand name safety switch known to meet the salient characteristics of this specification is Square D, Heavy Duty.

**2-10.0 FIRE PROTECTION:** All indoor insulating and acoustical materials, vapor barrier, covering and wrapping materials permanently attached or installed separately must not exceed flame spread 25 and smoke developed 50, as rated by Underwriter's Laboratories.

All conduits and pipes which penetrate floors (except ground floor) of multistory buildings and which penetrate fire barrier walls as designated in the Uniform Mechanical Code must have the excess void or cavity sealed with firestop compound. Compound must be Underwriters Laboratories, Inc. listed for use in through-penetration firestop system. Firestop must be "Flamesafe" Cat. No. FS 900 as manufactured by International Protective Coatings, Inc., or approved equal.

**2-11.0 DEMOLITION:** Any existing furniture, cabinets, equipment racks or other items which obstruct the Contractor's access to the work area must either be temporarily relocated by the Contractor to a storage area designated by the R.E. or be covered in a manner as to provide suitable access while protecting the Government property from construction damage. At the completion of all work, the Contractor must return all such items to their original location.

Any unused conduit, wire, duct, pipe, structural supports or other fittings associated with equipment or devices to be removed under this contract must also be removed.

All conduit must be totally removed unless approved by the R.E to only remove it back to the first existing junction box or electrical fitting. Remove all unused wire back to the source power panel. Any circuit which must continue to operate must be rewired for continuity. Seal all unused conduit with electrical plugs.

All refrigerant which is either a "CFC" or an "HCFC", as classified by the Environmental Protection Agency (EPA), must be recovered, decontaminated and recycled in accordance Section 608 of the Clean Air Act (40 CFR Part 82 Subpart F) during servicing or disposal of the refrigeration equipment. The National Recycling And Emissions Reduction Program, identified in Section 608 also contains provisions for certification requirements of individuals performing work on refrigeration systems. Contractors who perform maintenance, repair, service or disposal of equipment or appliances containing refrigerant must be certified by the EPA under Section 608 with Universal or Type II certification. Copies of certificates must be submitted to the FAA for all employees that will perform work involving refrigerants.

Intentional venting of covered refrigerant gases is subject to criminal penalties.

Remove unused structural support angles, channels, bolts, and similar hardware. Patch any holes resulting from removed equipment, hardware, conduit or pipe with the same material as that of the penetrated surface (ie: concrete floor openings must be filled with concrete). Paint patch to match adjacent undisturbed surface.

After removal of floor supported equipment, clean and/or replace any floor finish or covering to match adjacent undisturbed floor covering. Acoustical ceiling tiles or T-bar grid members which have holes resulting from removed duct or diffusers must be removed and replaced with new components of equal quality and appearance to the adjacent undamaged ceiling.

Any equipment or material to be removed, unless shown to be given to the RE, must become the property of the Contractor and must be transported from the site.

**2-12.0 FINISHES:** All exposed interior and exterior ductwork, piping, support structures, conduit, and electrical fittings installed under this contract shall be painted to a color selected by the R.E. Painting of indoor items shall consist of one coat of latex primer and one coat of exterior latex semi-gloss enamel. (Latex shall be used indoors to minimize odor.) Painting of outdoor items shall consist of one coat of oil based primer and one coat of exterior oil based semi-gloss enamel. Paint galvanized surfaces with one coat of "Speedhide Interior/Exterior Galvanized Steel Primer", No. 6-209 white, as manufactured by Pittsburgh Paint Company. Paints shall be certified by their manufacturer for use on the intended surface materials and shall be applied in accordance with his instructions. Latex paint shall be "Acry-Sheen" acrylic semi-gloss as manufactured by Evr-Gard Coatings, Paramount, CA, or approved equal. Oil based paint shall be specifically formulated for corrosion resistance and shall be high performance industrial enamel as manufactured by "Rust-Oleum", or equal.

**2-13.0 IDENTIFICATION:** The air conditioning equipment must be identified to show designator. Identify safety switches, power panels, cabinets, etc. to show equipment served, voltage, phase, and fuse amperage rating. Identify control panel and all controls to show function.

Identification must be by plastic engraved nameplates with white letters and black background. Letter size must be 1/8" for controls, 3/8" for devices on control panel covers and 3/8" for safety switches, air conditioning equipment and other equipment devices. Nameplates must be secured to equipment, cabinets and to controls with adhesive backing. In addition, nameplates installed outdoors must be secured with two screws.

Identify all new and modified pipes to show contents (i.e.: Chilled Water Supply, Refrigerant Suction, etc.) and flow direction. Identification must be with color coded, printed plastic bands secured around the entire circumference of pipe insulation. Bands must be "Setmark" as manufactured by Seton Nameplate Corp., or approved equal. Install bands on maximum 10 foot intervals and at each change of pipe direction.

**2-14.0 CLEANING:** Ducts, plenums, and casings must be thoroughly cleaned of all debris and blown free of all small particles of rubbish and dust before installing outlet faces. Equipment must be wiped clean, with all traces of oil, dust, dirt or paint spots removed.

**2-15.0 REFRIGERATION STARTUP REPORT:** After completion of the installation or modification of any refrigeration system, the following information must be recorded and submitted to the R.E. for approval.

Furnish a typewritten report documenting refrigeration system test data which must include the following:

- 1) System Number
- 2) Area Served
- 3) Date of Test
- 4) Name of Individual Certifying Test
- 5) Outdoor Air Temperature
- 6) Evaporator Entering Air Temperature
- 7) Type of Refrigerant

Show items 8 thru 17 for each refrigerant circuit:

- 8) Test Pressure and Ambient Temperature During Medium Pressure Leak Testing
- 9) Weight of Refrigerant in Each Circuit
- 10) Refrigerant Suction Pressure

- 11) Saturated Suction Temperature (show from chart)
- 12) Superheated Suction Temperature
- 13) Superheat (calculated value)
- 14) Refrigerant Condensing Pressure
- 15) Saturated Condensing Temperature (show from chart)
- 16) Subcooled Liquid Temperature
- 17) Subcooling (calculated value)
- 18) Motor Amps (Nameplate) (Show for all compressors)
- 19) Motor Amps (Measured) "
- 20) Motor Volts (Nameplate) "
- 21) Motor Volts (Measured) "

#### **2-16.0 AIR BALANCING AND DOCUMENTATION:**

Each air conditioning unit, air handling unit and fan-coil unit system shall be air balanced on 100% return air. Volume dampers on each branch supply duct shall be adjusted so that at least one diffuser volume damper on that branch duct is wide open and each diffuser is furnishing the specified airflow rate to within plus or minus 5% of the specified values. This will minimize the pressure drop across the final volume damper and limit transmitted noise. The Contractor shall be responsible for furnishing, installing and adjusting blower drive sheaves to achieve specified airflow rates on both new and existing air handling equipment. Setting of dampers and other volume adjustment devices shall be permanently marked so they can be restored if disturbed at any time. All air measurement readings taken during the adjustment work shall be recorded and two (2) copies of resulting data shall be furnished to the Resident Engineer for approval.

The organization performing the air balance shall be either NEBB or AABC certified.

Furnish a legible handwritten or typewritten report documenting air and water balance test data which shall include the following:

- 1) System Number
- 2) Area Served

- 3) Date of Test
- 4) Name of Individual Certifying Test
- 5) Design Air Quantities (CFM) - (show at each air handling unit's supply, return and outside duct connections and at diffusers, grilles, and registers)
- 6) Actual Air Quantities (CFM) - (Same as 5)
- 7) Actual Air S.P. (inches W.G.) - (Show pressure relative to atmosphere at blower inlet and outlet, at upstream and downstream side of filters, at upstream and downstream side of cooling and/or heating coils, and at return air duct connection and at supply air duct connection of air conditioning unit or air handling unit cabinet.)
- 8) Air Temperature Entering Cooling/Heating Apparatus
- 9) Air Temperature Leaving Cooling/Heating Apparatus
- 10) Motor H.P. (Nameplate) (Show for all fan motors)
- 11) Indoor Motor H.P. (Nameplate)
- 12) Indoor Motor Amps (Nameplate)
- 13) Indoor Motor Amps (Measured)
- 14) Indoor Motor Volts (Nameplate)
- 15) Indoor Motor Volts (Measured)
- 16) Indoor Motor RPM (Nameplate)
- 17) Indoor Fan RPM (Measured)

**2-17.0 INSTRUCTION MANUALS:** Upon completion of work, the Contractor must submit to the RE two (2) bound copies of an instruction manual. This manual must contain, but not be limited to, instructions for installation, operation and maintenance, replacement parts list, sequence of operation description, sizing and capacity data and manufacturer's guarantee information for all equipment furnished by the Contractor.

**2-18.0 SPARE PARTS:** Furnish one spare fuse for every fuse installed in every safety switch, air conditioning unit, control panel or other electrical device furnished under this contract. One

set must be placed in the enclosure of each of these devices. Furnish three spare sets of filters for each air handler or air conditioner.